Open Mines: Launching a Mini-Grant Program to Incentivize Open Educational Resource Development for STEM Disciplines

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Abstract

A common complaint among STEM faculty is the lack of existing Open Educational Resources (OER) to support upper class and graduate coursework. High-level courses or niche subject areas such as groundwater engineering or advanced manufacturing lack rigorous OER course material. Spearheaded by the Arthur Lakes Library, Colorado School of Mines was awarded an institutional-level grant by the Colorado Department of Higher Education to establish a mini-grant program. This program, *Open Mines*, would incentivize faculty on campus to use OER in their courses. This paper describes the Library's role in establishing the university's mini-grant program, an assessment of the first year of awards, and lessons learned. The initial grant cycle has been assessed in various ways, including data on cost savings to students and OER usage on campus. Lessons learned while administering the first cohort of mini-grants include addressing accessibility, dissemination, and copyright concerns. This project contributes to the discussion on the role of OER in STEM curriculum and techniques librarians can use to facilitate OER adoption at their institutions.

Introduction

According to the College Board's estimated student budget for 2018-2019, undergraduate students at public four-year institutions are expected to budget an average of $1,240 a year on textbooks and course supplies [1]. According to Mines' 2019-2020 Cost of Attendance, the institution informs students they should budget $1,500 a year on books and supplies, which means the university's approximately 5,000 undergraduate students should collectively budget $7,500,000 this academic year.

Universities are tackling the outrageous costs of textbooks and class supplies by promoting the adoption, adaption, and creation of Open Educational Resources (OER). OER are freely accessible learning materials for students to use and can be licensed for instructors to modify and redistribute. OER development in the Science, Technology, Engineering, and Math (STEM) disciplines has primarily been focused on large enrollment introductory courses such as Introduction to Mechanical Engineering or Introduction to Physics. A common complaint among Mines faculty is the lack of existing OER to support high-level courses or niche subject areas, such as groundwater engineering or advanced manufacturing. Recognizing the need for high-quality OER across the curriculum, the Arthur Lakes Library supports Mines faculty in adapting existing OER or creating their own open materials.

Some faculty at Mines have been using free resources in their courses for years, however the official "OER movement" on campus is relatively new. This movement was sparked by the work of a student group, For OER At Mines (FOAM), and a grant from the Colorado Department of Higher Education (CDHE). In 2017, Colorado established a state OER Council to develop recommendations to support OER adoption at public higher education institutions [2]. The next year, the Council funded $550,000 in individual and institutional-level grants to foster the adoption, adaption and creation of OER across the state. During the first grant cycle, CDHE funded Mines $30,000 to create an OER mini-grant program. This program awarded faculty at three levels: up to $500 for adopting an OER in a course, up to $2,000 for adapting an existing OER, and up to $5,000 for creating a new OER.

This paper describes the Library's role in establishing the university's mini-grant program, an assessment of the first year, and lessons learned. Mines' librarians took the lead in applying for and managing the institutional-level state grant and supporting awarded faculty. They also established an OER Steering Committee, with members from across campus, to promote OER, evaluate mini-grant applications, and facilitate campus discussion about textbook costs. Lessons learned while administering the first cohort of grantees include addressing accessibility, dissemination, and copyright concerns.

Literature Review

Much of the literature on OER adoption and use in higher education focuses either on the discussion of barriers and perceptions, or on ways to encourage faculty to join the movement. Several studies have examined the barriers to faculty participation and their perceptions of OER materials. Most faculty concerns center on control of their intellectual property, access to support on campus, and the time it takes to create an OER [3]. In an international study, Henderson and Ostashewski found that the greatest perceived barrier among study participants was the lack of institutional policies related to publishing and sharing OER [4]. Annual surveys by the Babson Survey Research Group report increasing awareness among faculty about OER, with almost 50 % of faculty acknowledging awareness in 2018 [5]. The 2018 survey also reports a growing dissatisfaction with commercial publishing among faculty, which could lead to increased OER adoption in the next few years [5].

Current literature also has examples of the role of OER in supporting student success, particularly in addressing learning outcomes and student perceptions of open materials [6]. E. Croteau's study, on the Affordable Learning Georgia project, examined student outcomes across 27 courses that had adopted OER. Croteau found that overall, faculty selected materials that saved students money without negatively impacting course learning outcomes [7]. In their study, Hendricks et al., examined the implementation of an open textbook in the University of British Columbia's Physics 100 course. They found that students overall appreciated that materials were customized to their particular course and considered them about the same or better than textbooks in other Physics courses [6]. In 2015, Fischer et al. conducted a multi-institutional study on the impact of open textbooks on student learning outcomes. They found that in some OER courses students were significantly more likely to complete the course [8].

Universities have begun to establish incentive programs to encourage faculty to implement OER

in their classes [9]. Some institutions incentivize through non-financial means, such as the University of British Columbia's addition of OER activities to their guidance on tenure and promotion [10]. Others, like Athabasca University, focus on widely used materials for which their faculty already own copyright [11]. However, many institutions have established financial incentives, typically in the form of mini-grant programs on campus. Most OER incentive programs are funded by their university's administration, local or federal government, or external grant programs. The amount of funding can vary depending on the needs and resources of the institution. In 2017, Shippensburg University gave faculty $500 to replace traditional textbooks with OER [12]. The project was funded by the Provost's office, and their grant amount was selected to be consistent with other funding projects coming from that office [12]. In 2015, University of North Carolina Greensboro awarded ten faculty $1000 each to restructure their courses to enable the adoption, adaption, or creation of OER [13]. Their project was funded by a grant from the North Carolina State Library [13]. Others, such as Manchester Community College in Connecticut, incentivize adoption by funding faculty to review and evaluate OER. The Manchester Community College project created a searchable repository of reviewed materials that faculty can feel confident in adopting [14]. The model of fostering adoption via faculty review of existing materials is emphasized by the Open Textbook Network (OTN) in their training for consortial and university members. They have found that 45 % of the faculty who attend an OTN workshop and write a review ultimately intend to adopt an OER for their course(s) [15].

Much of the discussion of OER use in STEM disciplines focuses on the implementation of OER in high enrollment introductory courses [16]. Hendricks et al. utilized the Physics 100 course in their study because it is a large enrollment, introductory course, and they were already revising the course and reorganizing course learning materials [6]. At the University of California Davis, ChemWiki was piloted as a replacement for a traditional textbook in one general chemistry course. Researchers found that students in the pilot section had comparable overall performance with students in the control section and self-reported spending more time interacting with course materials [17]. M. Shenoda, at Farmingdale State University examined the feasibility of replacing costly construction engineering resources with freely available government materials[18]. In their study, Paragarino et al. examined the discussion of OER taking place via Institute of Electrical and Electronics Engineers (IEEE) publication channels. They found 132 conference and journal papers published between 2008 and 2017 discussing OER in some capacity. The discussion via IEEE is largely taking place in their education-related conferences, such as *Frontiers in Education* and the *Global Engineering Education Conference* [19]. Many of the studies they examined discuss the implementation of OER in the classroom.

Other aspects of STEM OER literature discuss faculty and student perceptions of OER, especially supplemental materials such as test banks. Members of LOUIS, the Louisiana Library Network, partnered with OTN to host a series of workshops for faculty about OER, and their experience highlighted much of the discussion about OER in STEM. They found that faculty at their workshops raised concerns about losing access to supplemental materials such as homework problems and quiz banks that accompany many commercial STEM textbooks [20]. Nipa and Kermanschchi examined student perceptions of OER in a graduate engineering risk management course at the University of Texas Arlington. They found that engineering students were more likely than non-engineering students to have a more positive perception of OER in the course [21]. At Washington State University, Leachman and Anderson found their faculty struggle to find

suitable OER, particularly for higher level courses [22]. Difficulties finding appropriate materials was also expressed by the faculty who applied for the *Open Mines* mini-grant program.

First Cycle of *Open Mines* Grants

The Arthur Lakes Library at Mines leads OER efforts on campus by promoting the use and creation of OER, assisting in copyright and licensing questions, and identifying champions on campus. The institution's formal OER efforts began in 2017 with the coordinated work of the Scholarly Communications Librarian and FOAM, a student group which promotes OER use on campus and conducts interviews with faculty on OER usage, knowledge, and interest. However, the movement did not pick up significant momentum until 2019 when the campus received external funding from the state to develop a local campus incentive program.

Spearheaded by the Library, Mines was awarded an institutional-level grant to develop a mini-grant program, *Open Mines*, that would incentivize faculty on campus to use OER in their courses, as well as support workshops and other outreach efforts. The mini-grant program funded faculty at three award levels: up to $500 for adopting an OER in a course, up to $2,000 for adapting an existing OER, and up to $5,000 for creating a new OER (Table 1).

Table 1: Funding Requested for Mini-grant Program

Award Level	Funding for Award Level	Anticipated number of projects
I	$1,000	2
II	$6,000	3
III	$15,000	4

The program's first set of applications exceeded expectations with 14 applications, 11 of which were for OER creation projects (Table 2). The Committee was initially limited to $25,000 to fund awards, however, other campus units, including the Graduate Student Government (GSG), contributed an additional $15,500 to the program to support more projects. A total of 11 projects were funded at Award Level II or Award Level III. The funded projects will save individual enrolled students up to $255 for each of the resources replaced by an OER.

The first mini-grant cycle funded a diverse set of projects. In fact, only two of the creation projects were to develop textbooks. The other creation projects ranged from reading guides, similar to the "Spark Notes" concept, to simulation programs for lab equipment. Not all of the funded projects provide students with direct cost savings, but fill a gap in resources or provide students with additional educational materials. For example, the simulation program does not replace textbook costs, but will provide students with endless opportunities to interact with a $1,000,000 piece of lab equipment.

Expanding the OER Movement on Campus

Since the establishment of the mini-grant program, the OER community on campus has grown tremendously. As part of the CDHE grant, the campus established an OER Steering Committee to administer the grants and coordinate outreach and support efforts. The committee is chaired by

the Scholarly Communications Librarian and consists of librarians, faculty, instructional designers, undergraduate, and graduate students.

Table 2: —Mini-Grant Incentive Program

Project ID	Department	Course Level	Application Award Level	Award Level Funded
1	Physics	Undergraduate	I	II
2	Physics	Undergraduate	I	Not awarded
3	Physics	Undergraduate	II	II
4	Applied Math and Statistics	Undergraduate	III	Not awarded
5	Chemical and Biological Engineering	Undergraduate	III	II
6	Chemical and Biological Engineering	Undergraduate	III	II
7	Geology and Geological Engineering	Undergraduate & Graduate	III	III
8	Applied Math and Statistics	Graduate	III	III
9	Applied Math and Statistics	Undergraduate	III	III
10	Humanities, Arts, and Social Sciences	Undergraduate	III	III
11	Geophysics	Graduate	III	III
12	Physics	Graduate	III	III
13	Physics	Undergraduate	III	Not awarded
14	Mechanical Engineering	Undergraduate	III	III

Mines had applied for total of $67,500 from CDHE in the first grant cycle. The project was awarded $30,000, with the request to remove the $33,000 requested for an eight month Term OER Librarian salary. The Library then requested funding for the proposed Term OER Librarian from the university, however it was not funded and the outlined responsibilities were absorbed by the Scholarly Communications Librarian. Additional funding for more projects and the unanticipated number of creation projects forced the Scholarly Communications Librarian to creatively take on the work of the proposed Term OER Librarian's responsibilities.

The CDHE institutional-level grant outlined educational support for the mini-grant awardees through monthly forums and workshops on topics including open pedagogy, copyright, licensing, and accessibility. It was challenging to develop a workshop and forum series that would reach all of the grantees and meet their schedules. Instead, the Scholarly Communications Librarian developed an online certification program on the various OER topics.

The OER @ Mines Champion certification program was asynchronous and took participants approximately five hours to complete over the course of a month. The grantees were the primary target audience for the program, however it was open to anyone from the institution. The purpose of the program was to introduce faculty and faculty-track graduate students to the OER conversation and spark interest in Open Education initiatives on campus and within their discipline. In this first year, nine faculty and graduate students enrolled. At the end of this course,

the OER Steering Committee invited participants to join an OER coffee break discussion. The coffee break gave the OER campus community the opportunity to connect with the Steering Committee, students, grantees, and other OER advocates on campus in a casual setting.

The OER Steering Committee regularly hosts or participates in events in an effort to expand awareness across campus. For example, two members of the OER Steering Committee delivered a workshop at the campus' annual engineering learning conference. The Steering Committee also hosted an *OER Summit* to showcase the funded projects and increase campus participation. The one-day *Summit* included presentations and workshops by the Steering Committee, students, and grantees.

In addition to the Library's efforts in growing the Mines OER community, the CDHE provided training and networking opportunities for librarians, faculty, and instructional designers to build their OER skill set. For example, members of the Mines community were nominated to participate in an OTN training and become OER Campus Ambassadors. Professional development opportunities and funding from the state accelerated the local OER movement at Mines in ways that a purely library-driven effort could not achieve.

Discussion and Lessons Learned

The faculty at Mines often comment on the lack of open resources that meet their unique curricular needs, especially for high-level courses. The significant number of Award Level III applications received demonstrates a need for OER creation of various types of educational materials on campus. The skewed distribution of applications and course levels demonstrates a need for OER in these STEM fields and for high-level courses.

The majority of funded projects were for non-textbook OER creation. This indicates a need for diverse types of learning materials to support Mines courses. These non-textbook OER are a place where Mines faculty can use their unique expertise to make an impact beyond our institution on open education. However, the software, copyright, and accessibility needs of these unique, non-textbook resources can be difficult to navigate and require dedicated staff for support.

The unfunded Term OER Librarian position became a bigger obstacle than expected. While the OER Steering Committee was happy to receive additional funding from campus units, it resulted in supporting more time-intensive projects without the proper personnel. These staffing gaps negatively impacted the delivery of the program, the level of support for grantees, and quality of assessment. The Scholarly Communications Librarian was often behind the program's anticipated timeline or struggling to meet the institutional-level grant's objectives.

The first year of the mini-grant program provided many lessons learned, including identifiable gaps in grantee support and adjustments that needed to be made to the workflow. Support for copyright and resource accessibility were two areas the Scholarly Communications Librarian was challenged to find the necessary time to address properly.

Many of the *Open Mines* grantees proposed or began working on projects without first consulting on copyright. The Scholarly Communications Librarian reiterated her ability and availability to support copyright questions and concerns when grants were first awarded and in regular check-in emails, however she left it up to the grantees to reach out for this specific help. This "you come to

me" approach was an oversight. The Scholarly Communications Librarian learned months into the program that some grantees began adapting materials they had discovered online and assumed were openly available to be modified and shared. This led to a significant amount of back-tracking and quick permission requests to use and modify materials. In 2020, Mines was awarded a second CHDE grant, for $38,000 to fund a second year of the *Open Mines* mini-grant program. In the second cycle of mini-grants, applicants will be required to consult with the Scholarly Communications Librarian on potential copyright concerns before submitting their application.

Similarly to the copyright issues, the process in making resources accessible also presented challenges. As outlined by the CDHE call for proposals, all materials developed or adapted under the institutional-level grant must be compliant with the "Americans with Disabilities Act of 1990" (ADA). The large percentage of creation mini-grants made this process more time intensive than expected, especially without the dedicated support the Term OER Librarian would have provided.

The OER Steering Committee also learned that a mini-grant program within an institutional-level grant did not allow for much timeline flexibility. Extensions for the grantees caused delays in compliance with the institution's state-funded grant timeline. Resources developed under the program were required to be shared with the state approximately 16 months after receiving funding. This 16-month period was challenging to fully develop and deliver a grant program, which included establishing an OER Steering Committee, developing a call for proposals, reviewing applications, supporting awardees, reviewing resources, assisting with accessibility, and disseminating materials. The Committee agreed it was necessary to push up the timeline for the 2020-2021 grant cycle, allowing for some flexibility between the mini-grant deadlines and the institutional-level deadlines.

Conclusions and Future Work

The first year of the mini-grant program gained momentum for the OER movement across campus. Additional funding for the incentive program from campus units demonstrates wide-spread support for OER use throughout the Mines curricula. The results of grant year one and the lessons learned significantly informed the design of the application for the 2020-2021 grant cycle. The 2020 application requested $41,651 and was awarded $38,000.

The OER Steering Committee is now prepared to receive a significant number of Award Level III applications. However, OER creation is much more time and resource intensive than adoption or adaption. Therefore, the OER Steering Committee recognizes the need for dedicated support for the Mines OER community and was more strategic when requesting funds from the state. Instead of asking for the Term OER Librarian again, the application asked for two graduate student fellowship positions. The OER Fellow will provide much of the program support outlined for the proposed Term OER Librarian position, including marketing and data collection. The Accessibility Fellow will focus on supporting grantees to ensure that their resources are ADA compliant.

Without permanent funding from the university, the long-term sustainability of the OER movement on campus is unclear. External state funding, via the two graduate fellow positions, is

needed to demonstrate the Library's need for permanent staffing to support OER. At this time, the lack of dedicated staffing in the library for OER is the most significant barrier to fully realizing the OER program at Mines.

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